

AD-A110 126

CACI INC-FEDERAL ARLINGTON VA

F/6 15/5

GUIDELINES FOR ASSESSING LOGISTICS SUPPORTABILITY OF SHIPBOARD --ETC(U)

JUN 80 R A MARA

N00189-79-C-0325

NL

UNCLASSIFIED

1-1
1-1
1-1



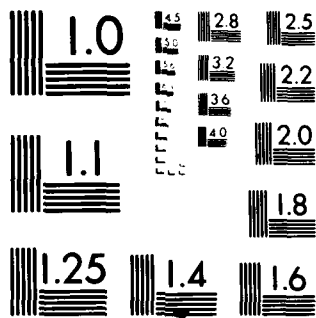
END

DATE

FILED

2-82

DTIC



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

AD A110126
DTIC FILE COPY

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

LEVEL 4

(1)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NONE	2. GOVT ACCESSION NO. AD-A110126	3. RECIPIENT'S CATALOG NUMBER 126
4. TITLE (and Subtitle) Guidelines for Assessing Logistic Supportability of Shipboard Systems		5. TYPE OF REPORT & PERIOD COVERED Final Report 16FEB79-30JUN80
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Ray A. Mara		8. CONTRACT OR GRANT NUMBER(s) N00189-79-C-0325
9. PERFORMING ORGANIZATION NAME AND ADDRESS CACI, Inc. 1815 North Fort Myer Drive Arlington, VA 22209		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 65865N 0841 A00
CONTROLLING OFFICE NAME AND ADDRESS Comptroller COMOPTEVFOR Norfolk, VA 23511		12. REPORT DATE 30JUN80
4. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 43
		15. SECURITY CLASS. (of this report) UNCLAS
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Integrated Logistic Support Plan Technical manuals Test equipment Initial outfitting list		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The assessment of logistic supportability (Test S-4) is an integral part of the operational test and evaluation (OTE) process. This report provides the Operational Test Director guidance for conducting this assessment. Because of terminology problems, aviation systems are not addressed. Test S-4 includes the following test elements: Adequacy of the Integrated Logistic Support Plan; Adequacy of the Maintenance Plan; Evaluation of Technical Manuals; (cont'd on back)		

DTIC
ELECTE
S JAN 27 1982 A D

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLAS 407236
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

UNCLAS

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(Block 20 continued)

- Evaluation of ~~Special Test Equipment~~;
- Completeness/consistency of periodic maintenance manuals;
- Evaluation of ~~Initial Outfitting List~~;
- Evaluation of maintenance requirements cards;
- Evaluation of maintenance time; and
- Evaluation of logistics effectiveness.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Guidelines for Assessing Logistics Supportability

G101. Introduction

a. As discussed in Section 9 of the basic Instruction, Test S-4, Logistics Supportability, is required in OPEVAL and OT-IV; some of its elements may be appropriate during earlier IOT&E. For the sake of completeness, this Annex concentrates on the problem of assessing logistics supportability during OPEVAL. Furthermore, this Annex addresses shipboard systems, not aviation systems; although the concepts remain the same, many terms differ.

b. By the time of OPEVAL, a system's maintenance concept should be well established; training, based on the system's operational and maintenance planning, should be outlined; logistics data requirements should be defined; and logistics and maintenance documentation should be at least in draft form. All these elements are interdependent and should have been carefully coordinated by the DA. Test S-4, Logistics Supportability, is designed to assess how well these elements are being developed, to assist in predicting how well the system will be supported operationally, i.e., in predicting how the system's operational availability will be affected by the logistics support system.

c. Test S-4, Logistics Supportability, has ten separate elements. These ten elements are listed below and are developed further in succeeding paragraphs of this Annex. In the following listing, those elements in Group A can be reviewed prior to actual test operations; those in Group B must be reviewed during test operations.



<u>Logistics Supportability Test Element</u>	<u>Group</u>	<u>Para</u>
Adequacy of the ILSP	A	G102
Adequacy of the Maintenance Plan	A	G103
Evaluation of Tech Manual to Supportability	A/B	G104
Evaluation of Special Test Equipment	A/B	G105
Completeness and Consistency of Periodic Maintenance Requirements Manuals	A	G106
Evaluate Initial Outfitting List	A	107
Evaluation of Maintenance Requirements Cards	B	G108
Evaluation of Maintenance Time	B	G109
Initial Outfitting List Effectiveness	A	G110
Logistics Effectiveness	A	G111

G102. Adequacy of the ILSP

a. General. The ILSP is the program manager's plan to ensure initial and continuing logistic support for his system. The purpose of evaluating the ILSP during OPEVAL is to ensure that the plan is complete and reasonable, and can be implemented in a fleet environment where the new system is simply one more system competing for logistics attention. The ILSP provided for OPEVAL should:

(1) Test the integrated support concepts stated in a generalized fashion in the conceptual and validation phases.

(2) Provide for collecting data for additional definition of concepts and to further validate logistics planning for production and deployment.

(3) Provide for Support of OT-III.

If the ILSP does not do these, it is unsatisfactory for OPEVAL.

b. Evaluation Procedure

(1) Review the appropriate instructions governing the contents of an ILSP. (The NAVAIRINST 4000.14 series, and NAVELEXINST 4000.10 series, copies are available through the Force Controller/Supply Officer.) Review paragraph G112, which summarizes key points to consider. Read the ILSP through once to get familiar with its organization and structure; use highlighter, underlining, marginal notes, or working notes to emphasize the key planning factors that affect logistics supportability.

(2) Having read the ILSP through and noted key planning factors, mentally assess its adequacy using the evaluation guides below. (These guides cannot be used as a check list since each ILSP is unique and prepared in a different writing style and organization. Rather, the evaluation guides are a general set of questions applicable to most ILSPs.)

(3) Evaluation Guides

(a) Maintenance Planning

1. Are the three levels of maintenance (organizational, intermediate, depot) stated, even though all are not used? NAVAIRINST 4790.4.

2. Have designations been made for intermediate and depot level maintenance activities? NAVAIRINST 4140.2 Series

3. If applicable, have designations been made for software maintenance?

4. Are planned and corrective maintenance tasks adequately defined at each level?

5. Are special maintenance skills and quantities of those skills defined at each level?

6. Is the maintenance plan for support and test equipment defined? NAVAIRINST 5400.72 Series

7. Are special or unusual maintenance personnel, equipment, facilities, etc. required? If so, does the ILSP state how they will be provided?

8. Is the military value of the system sensitive to its maintenance support requirements (i.e., if the system required half the total maintenance capability of the squadron would you recommend it)?

9. Is PMS (Planned Maintenance System) to be installed at OT-III, at least in preliminary form?

10. Are special tools required for maintenance?

11. Are new facilities; i.e., shop, building or maintenance area, required? Will they be ready when needed?

(b) Supply Support

1. Will an IOL be available for OT-III? Who will provide it? NAVAIRINST 4423.9 Series

2. Has a "Certificate of Integrated Logistics Support availability" been issued. NAVAIRINST 4000.2C

3. Is the supply support concept consistent with the organization/intermediate level maintenance support concept?

4. To what extent does the ILSP indicate that replaceable parts of the system are peculiar to that system alone?

5. Is the supply support concept in accordance with OPNAVINST 4441.12A?

6. Does the ILSP state how repair parts will be provided for the intermediate maintenance level? NAVAIRINST 4400.3 Series

7. Does the ILSP distinguish initial supply support normally provided by the equipment manufacturer and operational supply support normally provided by the supply system?

8. Does the ILSP provide for a smooth transition from interim support to operational support? NAVAIRINST 4400.3 Series, NAVAIRINST 4423.5 Series

9. Is the ILSP clear on the point that all requirements for provisioning the system apply equally to associated special support and test equipment? NAVAIRINST 5400.72 Series, 4700.6 Series, 5700.1 Series

10. Have repairable pipelines been outlined and will they appear to the operational personnel as normal repairable turn-in channels?

11. Are special requisition channels required? (These are not only a burden on the operational personnel, but are frequently forgotten, especially when the crew rotates.)

c. Support Resource Funding

1. Does the ILSP state that funding is being made available to support the system over its life cycle?

2. Does the ILSP identify unresolved problem areas concerning support resource funding?

3. Does the planned funding correspond to the project schedule?

4. If applicable, has funding been identified for software maintenance support?

(d) Support and Test Equipment

1. Are special test or support equipment or tools required by any level of maintenance?

2. Are special GPETE (general-purpose electronic test equipment) and SPETE (special-purpose electronic test equipment) requirements identified in the ILSP?

3. How will auxiliary pieces of special test equipment (connectors, cables, chart paper, etc.) be provided?

4. How will test equipment be calibrated?
NAVAIRINST 4355.14 Series.

5. Are integrated aircraft and systems tests to be specified in TMs or in PMS?

6. Does the ILSP state how the effectiveness of support and test equipment will be monitored during OT-III?

7. Where applicable, have arrangements been made to modify test equipment software in conjunction with software changes in operational equipment?

(e) PHS&T (Packaging, Handling, Storage and Transportation).

1. Are special containers, lifting rigs, and dollies provided?

2. Are special problems and solution during underway replenishment addressed?

3. Are transportation problems and solutions specified in accordance with OPNAVINST 4600.22 for systems which are over-size, overweight or require escort systems?

4. Has a logistic flowchart for hazardous articles been prepared?

5. Are reusable containers to be provided?

6. Are the reusable containers designed as shipping containers for repairable return or are additional shipping containers required?

7. Have special containers and special handling equipments been validated?

8. What special care is required for certain packages, such as wet-cell batteries?

9. Is packing material used in accordance with safety regulations?

10. Are special preservation requirements indicated?

11. Where applicable, have special handling precautions for integrated circuits been indicated?

) Technical Data

1. Does the ILSP require TMs to be prepared, validated, and available prior to IOC (Initial Operational Capability)? NAVAIRINST 5600.2 Series. Are draft TMs to be available not later than OT-III?

2. Does the ILSP indicate how TMs will be updated during production, testing, and early fleet introduction and operation?

3. Have draft or interim TMs been provided to COMOPTEVFOR prior to OT-III?

(g) Personnel and Training

1. Does the ILSP provide for early delivery of the system to the appropriate training site in order for installation prior to initial training?

2. Has training been planned for follow-on crews?

3. Is the Navy Training Plan available and complete?

G103. Adequacy of the Plan for Maintenance

a. General. Integrated Logistics Support is an iterative process. No single ILS element is the base on which all other elements depend. For supportability evaluation, however, it is convenient to consider the plan for maintenance as a basic document, evaluate it and then consider how well the remaining ILSP elements support it.

For surface systems, the plan for maintenance is stated in the ILSP. For aviation systems, the plan for maintenance is a separate document prepared in accordance with NAVAIRINST 4790.4A. While the process for developing the plan may be iterative, it is a basic document from which all logistics planning proceed.

(1) Surface Systems - See Section G102(3)

(2) Aviation Systems

a. Review NAVAIRINST 4790.4A and screen MIL-STD-2000(AS). Read the plan for maintenance through to get familiar with its organization and structure. Use highlighter, underlining, marginal notes or working notes to emphasize key factors that effect logistics supportability.

b. Having read the plan for maintenance through and noted key factors, assess its adequacy using the evaluation guides below. (These guides cannot be used as a check list since each system will have a unique plan for maintenance. Use the evaluation guides as a general set of questions applicable to most plans for maintenance).

(3) Evaluation Guides

a. General Considerations

(1) Is the plan format and contents in general agreement with NAVAIRINST 4790.4A and MIL-STD-2080(AS).

(2) Is the heading data complete?

(3) Does the narrative design description clearly identify each repairable item, their configuration, construction and special features?

(4) Does the narrative design description clearly indicate the system design features that most impact maintenance planning?

(5) Does the maintenance plan summary clearly address, for all three levels of maintenance, all unusual depth of frequency of maintenance, and unique requirements for manpower skills, facilities or test equipment? Are these in general agreement with the ILSP?

(6) Does the maintenance plan summary clearly indicate any limiting technical factors such as service life, maximum operating time, or age limit?

(7) Does the plan rationale appear sound and based on creditable documentation analysis?

b. Repair Capability

(1) Are all repairable items included? (Review against the top-down break down in the Technician Manuals).

(2) Are the source, maintenance and recoverability codes consistent with the direction of NAVAIRINST 4423.3A and with the maintenance requirement section (Part III)?

(3) Have Maintenance Replacement Factors been provided for each repairable item whose SM&R code indicates depot level condemnation?

(4) Have depot and system recovery factors been computed for each repairable and do they appear reasonable?

(5) Has a rotatable pool factor been computed for each repairable?

c. Maintenance requirements

(1) Do the maintenance requirements appear reasonable and consistent with your experience?

(2) Do the maintenance level and interval requirements appear reasonable?

(3) Is the ground support equipment reasonable for the maintenance task? Are the stated GFE requirements those which flight-line/IMA personnel will actually use without violating equipment or personal safety rules?

G104. Evaluation of Technical Manual Contribution to Supportability

a. General. Technical manuals issued by the Commander, Naval Air Systems Command are the only documents authorized for fleet operation and maintenance of aeronautical weapon systems and related equipment. NAVAIRINST 5600.20 contains information regarding the policies and responsibilities for NAVAIR technical manual program. (Section b.(1) and (2).)

Military Specification, MIL-M-008910(AS) provides detailed information regarding the contents of the illustrated parts breakdown.

b. Procedure

(1) Completeness. Check the total set of technical manuals delivered. Are all manuals required available? If any manuals are missing, report the shortage and request immediate delivery from the AM. If manuals are not available, ensure that this fact is included in the evaluation report.

(2) Format and Content. TMs should be prepared in accordance with MIL-M-5474 (and their Illustrated Parts Breakdowns in accordance with MIL-M-008910(AS)). Are they in compliance with these requirements? In this regard, sections or chapters of any manual which is incomplete or annotated with "To be determined" or words to that effect are unsatisfactory.

(3) Technical content

(a) Review the contents of each technical manual against the maintenance plan. Ensure that they are consistent as regards maintenance tasks, intervals, maintenance level to perform the task and support equipment requirements.

(b) Is the writing style intelligible? Are graphics provided where required? Are graphics clear, understandable and useful? Are test points clearly indicated? Are tabulated data clear, easy to interpret and difficult to misinterpret?

(c) Test TM content by requiring maintenance technicians to "read and tell", or if possible to "read and do".

(d) Check that the special tools and test equipment which are spoken to in the text and/or in tables are consistent with the maintenance plan and with the MRCs (where applicable).

(e) Assess the clarity and usefulness of the test equipment descriptions by requiring maintenance technicians to obtain and show a representative sample.

(f) Where test equipment is to be assembled from general purpose test equipment and special connectors or adapters, test the accuracy of the test set-up descriptions by requiring technicians to prepare the test bench using only the technical manual.

(g) Check the expected time required per maintenance cycle to prepare a test bench set-up.

$$T_{mc} = RPF \times UPE \times \frac{OH}{100} \times \frac{SU + DIAG + TE + DA}{Unit}$$

Where

RPF = Rotatable pool factor (from plan for maintenance)
UPE = Units per equipment
OH = Monthly equipment operating hours
SU = Test bench set-up time in hours
DIAG = Maintenance diagnostic time in hours
TE = Post repair maintenance time in hours
DA = Test bench disassembly and put away time in hours
UNIT = Units for which time is observed.

Determine if hours required for set-up will require, as a practical matter, a permanent dedicated test bench. If so, determine if space is available for the permanent test bench. If not, determine by interview with senior technicians, how they would overcome the problem (i.e., use existing test equipment).

G105. Evaluation of New Special Test Equipment

1. General. One of the criticisms made of the Navy is that it too frequently buys special purpose test equipment that is neither necessary nor desirable. The purpose of this test is to obtain an operational assessment of the true value of new special purpose test equipment.

2. Procedure

(a) Determine from a review of the technical manuals, and the Periodic Maintenance Requirements Manuals (PMRM) new pieces of special purpose test equipment.

(b) For each such piece assess its contribution to supportability as follows:

(1) Require that the test equipment be drawn from storage, set up, used to diagnose a failure, used to test a completed repair, disassembled and returned to stowage.

(2) Time each of the following steps:

SU	-	draw from stowage and set-up
DIAG	-	diagnosis
TE	-	test completed repair
DA	-	disassemble and return to stowage

(3) Request a senior and experienced technician to design a system to perform the same tests using currently allowed general purpose test equipment. If this is not possible, report the fact.

(4) Require the general purpose test equipment be drawn, set-up, used and disassembled as in sub-paragraph 2(a) and (b) above.

(5) Compute the following test equipment usage factor for the system assuming the most likely number of systems to use the gear (i.e., system is in x% of aircraft in a squadron/detachment of y aircraft; z squadron/detachments present).

$$UF = RPF \times UPE \times OH/100$$

Where UF = usage factor

RPF = rotatable pool factor (from plan for maintenance)

UPE = units per aircraft/month

OH = total operating hours of assigned aircraft with unit installed.

(6) Multiply the usage factor (UF) by the following expression for both the new and existing test equipment:

$$\frac{SU + DIAG + TE + DA}{\text{Unit}}$$

Where SU = drawn from tool crib and set up time in hours and tenths of hours.

DIAG = failure diagnostic time in hours and tenths of hours.

TE = post repair test time in hours and tenths of hours.

DA = disassembly and put away time in hours and tenths of hours.

UNIT = Units for which time is actually observed.

(Note: If the General Purpose Test Equipment is normally on the bench, draw time and put-away time = "0".)

(8) Assess the change in efficiency of the new equipment as compared to the old in terms of technician hours.

(9) Consider that the new equipment will be procured at some cost (unknown), will require its own set of technical documentation, will require supply system support competing with operational systems for repair parts budgets, will require maintenance and calibration (possibly at the Organization/Intermediate Level) and will require personnel training. From the best judgement available based on incomplete data, assess and report whether the new test equipment is of use at any total procurement cost or whether the equipment is of use provided its total procurement cost is not more than some dollar figure.

G106. Completeness and Consistency of Periodic Maintenance Requirements
Manuals

a. General. The purpose of this test is to ensure that the Periodic Maintenance Requirements Manuals (PMRM) incorporating Maintenance Requirement Cards (MRCs) are complete and consistent with the plan for maintenance. This test element may be accomplished before actual test and evaluation operations.

b. Procedure

(1) Check the various card sets received for the system against Table 1. This table, which was derived from MIL-M-23618E(AS), indicates which card sets should be expected depending upon the type of system which will be evaluated. Note that, if the system is to be installed in several aircraft types, there should be Introduction and Application Statement Cards, Panel Access Cards and Antenna Location Cards for each aircraft type. Report any card sets which are missing.

(2) Check the consistency of the plan for maintenance, the Maintenance Task Cards and the following Phase Maintenance Manual Cards:^{/1}

GSE Required List Card(s)

Consumable Material Card(s)

Replacement Parts List Card(s)

Maintenance Task Cards

(3) Check the consistency of the plan for maintenance and the following Planned Maintenance Inspection and Check List Manual Cards.

Removal/Replacement Schedule and Scheduled Removal Components Requirements Card(s)

^{/1} Or Acceptance Initial Build-up, Post Launch Servicing, Pre-operational Check Lists and Armament/Special Stores Manuals as appropriate.

b. Check the maintenance plan rotatable pool factor against the removal/replacement schedule and scheduled removal component requirements card(s) in the Planned Maintenance Information Card (PMIC) set. The rotatable pool factor for items with IMA Maintenance Codes should be somewhat higher than the removal/replacement schedule computation to allow for corrective maintenance.

$$RPF = \frac{\text{removal/replacement hrs}}{\text{Unit}} \times \frac{1}{\frac{\text{Operating hours}}{\text{Unit}}} \times 100$$

G107. Evaluate Initial Outfitting List (IOL)

a. General. The IOL is the basic supply support allowance document related to an aeronautical system. From a set of IOLs, aircraft configuration(s) in a deck load and projected flight hours for each aircraft, the logistics system computes the various consolidated supply support allowance lists such as AVCALs. It is essential to aircraft availability that the IOL(s) be accurate and complete.

An IOL has two or more parts which list the spare assemblies and repair parts necessary to maintain the aircraft, associated systems and support equipment at the organizational and intermediate maintenance levels.

Part I - Spares and repair parts which meet failure/cost criteria.

Part II - Spares which qualify as rotatable pool items.

Additional IOLs parts as may be necessary for other material support requirements (such as support of independently "deployable detachments").

Computing the range and depth of allowed items is a complex process requiring data not likely to be available to OPTEVFOR. Assessment of the IOL prior to flight line operations must be limited to its agreement with the plan for maintenance and assessing the general reasonableness of values used as measures of repair turnaround time.

b. Procedure

(1) Check that all items listed as rotatable pool items on the plan for maintenance (repair capability section) are also listed in Part II of the IOL.

(2) Check that all attrition/return for overhaul items listed on the plan for maintenance are also listed in Part I on the IOL.

(3) Based on the type of equipment being tested and the aircraft types in which it will be installed, assess the need for Parts III and greater.

G108. Evaluation of Maintenance Requirement Cards

a. General. In Section G106, the MRCs were compared to the plan for maintenance for completeness and consistency. The purpose of this test is to assess the MRC clarity and accuracy using the actual hardware and Navy technicians. The basic objective is to consider and simulate as near as possible operational conditions, cold, wet, dark atmosphere; crowded noisy distracting flight deck/hanger deck conditions.

b. Procedure

(1) Require that a senior technician well qualified and experienced in the aircraft type, review all warnings and cautions. Make notes of any warnings/cautions that do not appear adequate considering the worst likely operational conditions that could be expected (i.e., flight deck operations in the dark in foul weather). Require that these additional warnings/cautions be followed.

(2) Require that each Maintenance Task Card be demonstrated by a technician(s) of the grade and qualification required by the card.

(3) Observe and note the following:

a. Are GSE/consumable requirements stated in the text of the card summarized in the card heading? Are all individual card GSE/consumable requirements summarized in the deck set of GSE and consumable/repairable cards?

b. Are the maintenance task steps logical and sequential?

c. Where sight inspections are required, can the components be sighted completely or are they fully or partially obscured?

d. Can all damaged/loose fasteners be seen or felt?

e. Do inspection procedures indicate the "proper" position in lieu of stating "positioned properly"?

f. Where QA is advisable (required when maintenance tasks, if improperly performed, could cause equipment failure or jeopardize the safety of personnel) are the maintenance task cards so marked. Is the QA card cross-referenced to the proper maintenance task card? Observe the QA check. Was the QA performed as expected?

g. Where assistants are required, are the task cards cross-referenced to the proper assistant card number? Are the task cards clearly understood by both parties as to their specific responsibilities?

h. Test the clarity of GSE descriptions by having the technician obtain the required GSE. Note all cases of wrong GSE obtained by the technician. For each card tested, note the time (TGSE) required to obtain the required GSE.

i. Test the clarity of consumable/repair part descriptions by having the technician obtain the material. Note all instances of incorrect consumables/repair parts. Note the time (TMAT) required to obtain the material.

j. Note the time specified on the maintenance task card, the time actually required to perform the task and the periodicity of the task. Compute the ratio:

$$MTF = \frac{\text{actual maintenance time}}{\text{scheduled maintenance time.}}$$

$$MMTF = \frac{\sum MTF}{\text{maintenance actions observed}}$$

k. Even though not otherwise required, require that each system component be removed from the aircraft and replaced as would be required for timed removal/failure.

1. By interview with a senior, experienced and qualified technician and the technician actually performing the task, assess:

1. Is the task feasible under shipboard conditions?

2. Under shipboard conditions, what unauthorized and dangerous short-cuts might be attempted? If any, recommend corrective action.

3. Can the task be simplified, streamlined?

4. Are the GSE requirements adequate? If new GSE is specified, is there existing GSE which will suffice especially considering the elapsed time of obtaining, setting up using, breaking down and restowing the special GSE?

5. Are the instruction for setting-up and using the GSE clear?

G109. Evaluation of Maintenance Time

a. General. The purpose of this test is to evaluate overall maintenance time that will be required for the system based on the logistics documentation at OT-II/III. Total maintenance time can be inferred from the expected planned maintenance time required, expected corrective maintenance frequency, the MTTR and delays required to obtain material, tools and test equipment. If MIL-STD-471A (Maintainability Verification/Demonstration/Evaluation) Phase 3 has been invoked in the contract for OPEVAL, data from this verification should be used in lieu of the following procedure:

b. Procedure

(1) Corrective maintenance - organizational level.

a. Obtain the total number of equipment operating hours and maintenance actions performed in the observed period (See G108).

$$\text{Compute MTBF}_{\log} = \frac{\sum \text{Operating Hours}}{\text{Corrective Maintenance Actions}}$$

b. Compute expected failure per maintenance cycle

$$EF_{mc} = MTBF_{\log} \times \frac{OH \times UPE}{100}$$

c. Obtain from the Maintenance Action Forms the total number of organization man-hours required to remove and replace failed components. Compute:

$$MTTR_o = \frac{\sum \text{Hours to remove/replace}}{\text{Total corrective maintenance actions}}$$

d. Compute the expected corrective maintenance time per maintenance cycle

$$EMT_{co} = EF_{mc} \times MTTR_o$$

(2) Planned maintenance - organizational level. From the Maintenance Requirements System:

a. From Index Card(s) for PMIC, list each maintenance task card except for conditional tasks. Multiply the scheduled total man-hours for organizational personnel by the average monthly periodicity of the task (i.e., daily checks = 2.0 hrs x 30 = 60; even calendar = .05).

Total the planned maintenance hours/month and multiply by expected maintenance cycles.

$$MT_{pc} = (\text{Time per Maintenance Task}) \times (\text{Periodicity/month}) \times \frac{OH \times UPE}{100}$$

b. From the maintenance task cards for special checks, multiply the scheduled total time required by the expected number of checks per month expressed in maintenance cycles.

$$MT_{ps} = (\text{Time per Maintenance Task}) \times (\text{checks/month}) \times \left(\frac{OH \times UPE}{100} \right)$$

c. Compute total planned maintenance per maintenance cycle

$$MT_{po} = MT_{pc} + MT_{ps}$$

(3) Compute total expected organizational level maintenance time per maintenance cycle

$$MT = (EMT_{co} + MT_{po}) \times (MTF)$$

Where MTF = the observed ratio of actual maintenance time to scheduled maintenance time (from Section G108).

(4) Corrective maintenance - intermediate level.

(a) Obtain from the Maintenance Action Forms, the total number of intermediate man-hours required to perform the repair.

$$MTTR_I = \frac{\sum \text{Hours to repair}}{\text{Total corrective maintenance actions}}$$

(b) Compute corrective maintenance time per maintenance cycle

$$MT_c = MTBF_{log} + MTTR_I \times \frac{100}{OH \times UPE}$$

(5) Planned maintenance - intermediate level.

(a) From the Planned Requirements System Index Cards for PMIC, list each maintenance action assigned to the intermediate level and each maintenance action where the Aircraft Maintenance Department (AMD) has an "assist function", and "QA functions".

(b) Except for "conditional tasks", compute maintenance hours required:

$$MT_{pc} = \left[\sum (\text{Maintenance Task Time}) \times (\text{Periodicity/month}) \right] \times \frac{\text{Op hours/month}}{100}$$

(c) For "special" checks, compute maintenance hours required.

$$MT_{ps} = (\text{Time per Maintenance Task}) (\text{Checks/month}) \times \left(\frac{OH \times UPE}{100} \right)$$

(d) Compute total planned maintenance

$$MT_p = MT_{pc} + MT_{ps}$$

(e) Compute the averages as follows:

$$MT_{GSE} = \frac{\sum TGSE}{\text{Maintenance actions observed}}$$

$$MT_{MAT} = \frac{\sum TMAT}{\text{Maintenance actions observed}}$$

(f) Compute total expected intermediate level maintenance time per maintenance cycle

$$MT = (MT_c + MT_p) \times (MT_{GSE} \times MT_{MAT} \times MMTF)$$

G110. IOL Effectiveness.

a. General.

(1) The purpose of this test is to determine the effectiveness of the IOL in supporting system maintenance as well as to make a general assessment of replacement/failure rates used to computed allowed quantities. The latter point is significant because, if the acquisition contract has provided an incentive for reliability, the contractor may have optimistically estimated the reliability and thereby underestimated component/part failure rates.

(2) To check IOL allowed quantities against experience, it is necessary to understand the IOL column headings. These headings although labeled as aircraft numbers actually represent maintenance cycles. The conversion of aircraft numbers to maintenance cycles is accomplished as follows:

IOL column heading (acft)	1-6	7-17	18-29	30-42
Highest flying operating hours/ 90 days (base 35 hours/mo)	$\frac{630}{6 \times 35 \times 3}$	1785	3045	4410
Range of flying hours	1-630	631-1785	1786-3045	3046-4410
Avg acft range	3	12	24	36
Avg operating hrs in range (i.e., highest hours in range x avg acft highest acft)	315	$\frac{1260}{(1785 \times 12/17)}$	2520	3780
Maintenance cycles (100 hrs = 1 maintenance cycle)	3.2	12.6	25.2	37.8

D.

(b) Procedure

(1) Starting as early as possible in OT-III (or if possible OT-II) require that a diary of system operating hours be maintained. The goal is to accumulate an operating history of about three times the specified system Mean Time Between Failures (3 x MTBF).

(2) Starting as early as possible in OT-III (or if possible OT-II) require that all attrition items (repair parts), depot level repairables, and rotatable pool item replacements be documented on DD Forms 1348. Ensure that such documentation is made whether the item is replaced by Naval or contractor personnel.

(3) During OT-III, especially, ensure that all repairables designated for organizational or intermediate repair are actually repaired at that level and are properly documented by Maintenance Action Forms. Note that it may be necessary to institute a serial number control to ensure that failed parts are not replaced with factory parts unless that action is authorized by the Test Director.

(4) Compute the IOL gross effectiveness (i.e., total number of parts required and listed in Part I of the IOL).

a. Compute the maintenance cycles observed

$MC = \text{Total recorded equipment operating hours} / 100$

b. List the total number of repair part/repairable item requirements for each maintenance action.

c. List the total number of requirements that are not listed on the IOL in the column most nearly related to the computed maintenance cycles (MC).

d. Compute gross effectiveness

$$IOL_{GE} = \frac{\text{Total requirements} - \text{requirements not listed}}{\text{Total requirements}}$$

(5) Compute the IOL Net Effectiveness (i.e., Total number and quantity required and not listed in Part I of the IOL in sufficient depth.

a. Compare the number of requirements listed with the IOL quantity in the column most nearly related to the computed maintenance cycles (MC). Note that the IOL is intended to cover 90 days of support.

b. Compute IOL Net Effectiveness

$$IOL_{NE} =$$

$$\frac{\text{Total requirements} - \text{requirements listed in qty less than required}}{\text{Total Requirements}}$$

(6) Compute rotatable pool effectiveness

a. For each rotatable pool item inducted into the IMA, compute the average Turnaround Time

$$TAT = \frac{\text{Time from removal to return to shelf RFI}}{\text{Total number of removals}}$$

b. For each rotatable pool item compute the rotatable pool factor (RPF).

$$RPF = \frac{\text{Removals} - \text{Removals not repaired by IMA}}{\text{Observed maintenance cycles (MC)}}$$

c. Calculate the rotatable pool protection quantity

$$RPQ = \frac{RPF \times TAT \times MC}{90} + \sqrt{\frac{RPF \times TAT \times MC}{90}}$$

(round up based if decimal is 0.5 - 0.9; except where RPQ

≥ 5.86 compute $\frac{RPF \times TAT \times MC}{90}$, add 1.0 and round up)

d. Compare computed RPQ to the appropriate column in IOL. List all rotatable pool items which do not match and the difference between the computed RPQ and the IOL quantity.

e. Compute rotatable pool effectiveness

$$RP_E = \frac{\text{IOL Part II Items with quantities} \geq RPQ}{\text{Items listed IOL Part II}}$$

f. Differences in rotatable pool allowed quantities can result from differences between observed and assumed RPF or observed and assumed TAT or both. Assumed RPF values for each pool item are listed in the plan for maintenance. For each rotatable pool item whose allowed quantity is different from the computed RPQ value, compare the observed RPF with the RPF in the plan maintenance. List all items, the computed RRF quantity and the plan for maintenance RPF quantity.

G111. Logistics Effectiveness

a. General. For shipboard systems, it is a reasonable assumption that systems must be available for use at any time while the ship is at sea. This assumption makes it possible to assess logistics effectiveness as that part of the time when the system will not be available for any reason.

However, for airborne systems, mission time is planned to be only a small portion of the total calendar time. Any aircraft downtime not related to the downtime caused by the equipment being evaluated makes it difficult to argue that the candidate system was not available. It is possible to argue that effective logistics support for any given system minimizes the probability of a system failure occurring and being discovered from the period one flight line repair time prior from launch to completion of mission (which may be one-half flight time for a weapons system to full flight time for a navigation or control system). The variables inherent in any given failure and in the probability of flight line repair preclude any reasonably simple mathematical treatment which would withstand the force of counter argument. Therefore assessment of logistics effectiveness of aviation system must be drawn by subjective, informed judgement based on all the previous test results.

G112. ILSP Evaluation Considerations

a. Introduction

(1) Most systems and equipments intended for use by the aeronautical organization will be sponsored by NAVAIRSYSCOM or NAVELEXSYSCOM. This discussion concentrates on ILSPs issued by these two commands.

(2) The NAVAIRSYSCOM ILSP system (see NAVAIRINST 4100.14 series) requires an initial plan be prepared in loose leaf form and be updated progressively as changes occur.

(3) The NAVELEX ILSP system (see NAVELEXINST 4000.10 series) requires development of a single ILSP that is successively updated by letter revisions.

(4) Regardless of its format or technical content, an ILSP should direct a set of actions to achieve a stated objective. The plan must indicate by whom, when and how each required action will take place. The plan should recognize problem areas and provide for alternative approaches. It should require a demonstration and validation of data required for decisions. Action milestones should be provided that are logical, sequential, and realistic. Where the plan requires action by activities outside the chain of command of the sponsoring DA, there should be an indication that these activities agree to perform the actions.

b. Elements of Integrated Logistics Support

(2) Reference texts and instructions concerning ILS (integrated logistics support) define distinct elements that comprise the ILS discipline. From the viewpoint of intermediate and organizational aircraft maintenance

activities, the IL elements that have the greatest impact on aeronautical systems are:

- (a) Maintenance planning.
- (b) Supply support.
- (c) Support resource funding.
- (d) Support and test equipment.
- (e) Transportation and handling.
- (f) Technical data.
- (g) Personnel and training.

The ILSP evaluation criteria provided below address all the above elements. Adequacy of technical data and personnel and training are normally covered in other S-Tests; only essential information of inter-element significance is given herein to these elements.

c. Maintenance Planning. This element is concerned with maintainability and reliability as well as with maintenance organization. The former are addressed by OPTEVFOR in different S-Tests. Maintenance organization is described herein. Maintenance planning in the Navy is normally conducted within the context of a three-echelon maintenance system. The echelons are: organizational, intermediate and depot.

- (1) Organizational maintenance is maintenance performed at the squadron level, either preventive or corrective. Normally organizational maintenance is performed using only squadron assets plus spare parts that, in some cases, must be obtained from sources external to the squadron.
- (2) Intermediate maintenance, the next level of maintenance above organizational, is performed by personnel from an intermediate maintenance activity such as a tender, SIMA

(Shore Intermediate Maintenance Activity), MOTU (Mobile Technical Unit), or selected contractors. Intermediate maintenance may be planned or corrective.

- (3) Depot maintenance is normally performed by personnel from a a Navy DOP (Designated Overhaul Point), a maintenance contractor or the equipment/system manufacturer. Depot level maintenance is almost always corrective and is usually performed at the depot or overhaul point.

The ILSP should summarize the general concept for equipment/system maintenance. The primary maintenance echelon should be designated for both corrective and planned maintenance. The role of each maintenance echelon should be addressed. If these roles are not described, the ILSP should specifically indicate the reasons for the omission and the alternative plan. The maintenance plan forms the basis of ILSP. Other elements must merge into the framework established by the maintenance plan. Where software is an integral part of the system, support planning must also include software maintenance planning for both the basic system and software critical test equipment.

d. Supply Support. In general, supply support must be designed to support the new system based upon the system maintenance concept. Supply support must consider support of the equipment as well as support of the ground support equipment. Within the Navy Material Command, the Naval Air System Command is responsible for the logistics support of all ground support equipment except General Purpose Electronics Test Equipment (GPETE) as defined by NAVMATINST 5430.52 series. GPETE is the logistics responsibility of NAVELEXSYSCOM.

Supply support documentation is divided into Initial Outfitting Lists (IOL), Tables of Basic Allowance (TBAs), Allowance Equipage Lists (AELs),

and Allowance Parts Lists (APLs). Preliminary versions of IOLs, TBAs, AELs and APLs should be available.

- (1) The level of repair parts and system backup (wholesale stocks) is tightly constrained by DOD and CNO directives.
- (2) Over the life cycle of the system, the supply support and maintenance support concepts often drift to be essentially the same as those for all other equipments/systems on the ship.

For these reasons, the ILSP must be feasible, practical and sustainable over the life of the equipment/system. In order to be so, specifics of the supply support concept must be stated in the plan.

e. Repair Parts. A prime facet of supply support is the availability of repair parts. These include parts peculiar to a specific equipment or to a limited number of equipments, and parts common to many equipments. Because of the method used to compute allowances of repair parts, the more common a part is, the greater the probability that the part will be allowed.

f. Provisioning. Provisioning occurs after the production design has been finalized. It will be normal that parts support during OPEVAL will contain many spares denoted by a manufacturer's part number, since the provisioning process has not yet been completed. In order for provisioning to be accomplished, the contractor must provide certain provisioning technical documentation to the Program Support Inventory Control Point (PSICP). To ensure that this is done, either MIL-STD-1552/1561, MIL-P-15137C, or MIL-STD-1375 must be cited in the production contract. The necessity to require provisioning technical documentation is sometimes overlooked; during review of an ILSP, ensure that the intent to require provisioning technical documentation is described.

g. Transportation and Handling of Repairables. If the new equipment/system is to be supported by exchange of repairable components, the ILSP should describe the type of packaging for use in protecting the repairable when it is sent to the DOP (Designated Overhaul Point). Often a valuable failed component is damaged beyond economical repair during shipment to the DOP because of improper packaging.

h. Repairables System.

(1) Repairables normally are established by the maintenance plan, but execution of the routing for repairables in order to obtain the needed corrective maintenance is a supply support function. The repairables system, which should be described in detail in the supply support section of the ILSP, may consist of one of the following:

- (a) Rotatable pool
- (b) Depot-level automatic induction
- (c) Depot-level non-automatic induction

(2) Under the rotatable pool plan, a failed item is exchanged at an intermediate maintenance activity for a reconditioned one. The failed item is inducted for repair and made ready for reissue. To be effective, a rotatable pool requires that technical skills, test equipment, spares, industrial equipment, and facilities be available. In addition, a sufficient number of the components must be available in the same geographic area to support the pool.

(3) The supply system interface is predominant in depot level automatic induction for repair of components. The failed item is replaced from the supply stocks and then shipped for repair to a depot level activity (a naval industrial activity, or a contractor's plant). Because the depot has an approved open work order in effect, the depot inducts the component

into the repair process as soon as it is received. When repair or restoration is complete, the item is returned to the supply system for reissue. Automatic induction is usually reserved for very expensive items that require fast turn-around.

(4) An important part of depot-level non-automatic induction is that the failed item is first replaced with an item drawn from supply stocks. When the failed component is subsequently shipped to the DOP, it becomes one of many similar items in a pool awaiting repair. When a sufficient number of items requiring repair have accumulated in the pool, a contract is negotiated for repair of the lot. Once repaired, the items are returned to the supply system for reissue on demand.

i. Interim Supply Support

(1) Contractual arrangements are often made with the manufacturer to provide supply support during fleet introduction, to reduce the Navy's investment in parts that may not be used and to ensure that the equipment is supported during a period when supply system stocks are incomplete.

(2) The ILSP should describe the early supply support plan in detail. The plan directed in the ILSP should establish a system that will permit the fleet to treat all items of supply, regardless of wholesale source, in a consistent manner. Compliance with differences in procedure must be the responsibility of ASO or other PSICP. The fleet personnel should be able to process all requisitioning and all failed items the same way. The interim support plan should, as a minimum, identify authorized levels of repair and repairs sites, define the method of replenishment and requisitioning channels; identify supply aids to activities responsible for preparation, and the duration of interim support.

j. Support Resource Funding. The purpose of this element of ILS is to identify representative life cycle costs over all ILS elements including software. Any elements excluded from the life cycle cost process must be defined and the rationale for any such exclusion must be presented. Planned funding stated in this ILSP section must correspond to the milestone schedule appearing in a section of the ILSP. Deficiencies in funding should be identified, together with impacts, alternatives, and contemplated remedial actions. Supportability will be concerned with support resource funding if the ILSP indicates funding shortages in any logistics element. OPTEVFOR should make operational estimates of the validity of support resource planning.

k. Ground Support and Test Equipment

(1) In this section of the ILSP are stated the logistics considerations concerning support equipment, SPTE (special-purpose test equipment) and GPTE (general-purpose test equipment). In this section, supply support, maintenance, calibration plans, and technical data for S&TE are defined in detail, even though they are mentioned in other sections of the ILSP. Although most plans do cover how the S&TE is to support the prime equipment, the planning factors necessary to ensure support of the S&TE are often overlooked. In addition, personnel and training requirements for operation, repair, and calibration of the various types of test equipment are often omitted from the ILSP as are plans for software maintenance. These cause severe problem in logistics support of the test equipment and ultimately of the prime equipment. Too few technicians trained in test equipment repair and calibration, or too few designated calibration sites render test equipment practically useless. Personnel and training plans for S&TE should be addressed in the Personnel and Training section of the ILSP and mentioned in the S&TE section.

(2) Special tools, protective shields, external cabling, probes, lube oil carts, etc. that are required on board must be accorded the same planning status as test equipment, to ensure that the prime equipment will meet operational requirements.

1. Transportation and Handling. Within this section of the ILSP should be the procedures and assigned responsibilities to move the prime, support, test, and repair equipment necessary for installation, test and evaluation, acceptance, operation, and follow-on support. Preservation and packing standards expected to be involved should be described. The activities responsible for shipping must be named. The plan for reuse of shipping containers should be stated. The inventory managers for reusable containers and for handling equipment should be named. Requirements (when and by whom) for furnishing pertinent supply management data (e.g., provi-

sioning, maintenance instructions) for reusable containers and handling equipment should be specified. The plan to describe what is to be accomplished to demonstrate transfer-at-sea capability, if required, should be stated.

m. Technical Data. The Technical Data section of the ILSP mainly refers to TMs and drawings that are required to be supplied with the equipment or system. Usually during OT-III, not all TMs and drawings are available for review. In their absence, draft documents or as a minimum planning for those data can be determined from the ILSP. In this section, the format and technical content of the TMs for the three levels of maintenance should be described. TM updating procedures over the life cycle of the equipment or system must be detailed. The preparation, storage, distribution, and change control for drawings should be described. Although the Technical Data section is often short, it must contain the above information at a minimum. Supportability over life cycle is threatened if planning for furnishing technical data is not adequately described in the ILSP.

n. Personnel and Training. This ILS element is important because of the effect of a lack of personnel or training on supportability. This ILSP section should address technical manpower, billets, crew scheduling and phasing, Navy instructor, billets, industrial personnel training, rate and ratings to be trained, rates and ratings required on board, NECs, NOBCs, officer billets and training, and the personnel pipeline. The initial and follow-on training concepts should be described in the ILSP and reference made to the current NTP (Navy Training Plan). In addition, the life cycle cost of personnel and training should be stated.

	Aircraft Weapons and Drone Aircraft						Powered Aerial Targets (Missiles)			GSE or Power Surface Targets Manuals	Airborne Armament Equipment or Specialized Stores
	Phased Maintenance Manual	Daily/Servicing/Special Manual	Turn-around Check List Manual	Quick Engine Change Assembly Manual	Planned Maintenance Inspection Check List Manual	Acceptance/Initial Build-up Manual	Pre-Launch Manual and Post Launch Servicing Manual				
Title Card	X	X	X	X	X	X	X	X	X	X	X
List of Effective Cards	X	X		X	X	X	X	X	X	X	X
Intro and Application Statement Card(s)	X	X	X								
Format Description Cards	X	X	X	X	X	X	X	X	X	X	X
Definition Card(s)	X	X	X	X	X	X	X	X	X	X	X
Abbreviations Index and Check Flight Requirement Card(s)	X	X		X							X
Phased Manual	X										
Abbreviation, Index, and Check Flight Requirements											
QEC/Phase Application Cover Card	X		X	X							
GSE Required List Cards(s)	X	X	X	X				X	X	X	X
Consumable Mat'l Card(s)	X	X	X	X				X	X	X	X
Replacement Parts List Card(s)	X	X	X	X				X	X	X	X
Work Area(s)/Zone(s) Card(s)	X	X	X	X				X	X	X	X
Access Panels Cards	X	X						X	X	X	
Antenna Locations Card(s)	X	X						X	X	X	
QA Cards	X	X		X				X	X	X	X
Sequence Control Card(s)	X							X	X	X	
Periodic Inspection Schedule											
Maintenance Requirements Task Cards(s)	X	X		X				X	X	X	X
Removal/Replacement Schedule and Scheduled Removal Components Requirements Card(s)					X						
Record of Applicable Technical Directives Card(s)					X						
Maintenance Requirements System Index Cards					X						
Conditional Inspection Listing Cards					X						
Phase Change Implementation Cards					X						